

CLAIMS

What is claimed is:

1 1. A system for protecting a network comprising:
2 a plurality of links located in said network;
3 a transmitter switch, coupled to a first end of each link of said plurality
4 of links, for transmitting distinct data along each link of said plurality of links;
5 and
6 a receiver switch, coupled to a second end of each link of said plurality of
7 links, for receiving said distinct data from each link of said plurality of links;
8 wherein said distinct data transmitted along one link of said plurality of
9 links is switched to another link of said plurality of links when a failure is
10 detected on said one link.

1 2. The system according to claim 1, wherein said network is an
2 Asynchronous Transfer Mode (ATM) network.

1 3. The system according to claim 1, wherein said network is a Frame
2 Relay network.

1 4. The system according to claim 1, wherein said transmitter switch
2 further comprises a transmitter line card coupled to said first end of each link of
3 said plurality of links.

1 5. The system according to claim 4, wherein said distinct data
2 transmitted along each link of said plurality of links comprises cells.

1 6. The system according to claim 5, wherein said transmitter line
2 card further comprises a transmitter classifier module for classifying said cells
3 transmitted along each link of said plurality of links, a plurality of transmitter

4 queuing buffers coupled to said classifier module, for receiving and storing said
5 cells, and a transmitter multiplexing module coupled to each buffer of said
6 plurality of transmitter queuing buffers and to each link of said plurality of
7 links, for directing said cells stored in each buffer in a predetermined order to a
8 corresponding link of said plurality of links.

1 7. The system according to claim 6, wherein said transmitter switch
2 receives a virtual connection setup request and assigns at least one virtual
3 connection corresponding to said virtual connection setup request alternatively
4 to each buffer of said plurality of transmitter queuing buffers.

1 8. The system according to claim 7, wherein said at least one virtual
2 connection is associated with said cells transmitted along each link of said
3 plurality of links.

1 9. The system according to claim 7, wherein said transmitter switch
2 assigns said at least one virtual connection to each buffer of said plurality of
3 transmitter queuing buffers in such a way so as to ensure that each link has a
4 balanced load.

1 10. The system according to claim 8, wherein said transmitter
2 classifier module allocates said cells to each buffer of said plurality of
3 transmitter queuing buffers based on association with said at least one virtual
4 connection, in such a way so as to ensure that each link has a balanced load.

1 11. The system according to claim 6, wherein each buffer of said
2 plurality of transmitter queuing buffers includes a plurality of Quality of
3 Service (QoS) category queues.

1 12. The system according to claim 6, wherein said transmitter line
2 card further comprises a transmitter processor for monitoring each link of said
3 plurality of links and for programming said transmitter multiplexing module to
4 switch said distinct cells transmitted along said one link of said plurality of
5 links to said another link when said failure is detected on said one link.

1 13. The system according to claim 6, wherein said receiver switch
2 further comprises a receiver line card coupled to said second end of each link of
3 said plurality of links.

1 14. The system according to claim 13, wherein said receiver line card
2 further comprises a receiver multiplexing module coupled to each link of said
3 plurality of links, for merging said cells received on each link of said plurality
4 of links and a receiver classifier module coupled to said receiver multiplexing
5 module, for classifying and outputting said cells to a plurality of receiver
6 queuing buffers.

1 15. The system according to claim 14, wherein said receiver line card
2 further comprises a receiver processor for monitoring each link of said plurality
3 of links and for instructing said transmitter processor of said failure of said one
4 link.

1 16. The system according to claim 5, wherein each cell comprises a
2 transmission header having a virtual circuit identifier (VCI).

1 17. The system according to claim 5, wherein each cell comprises a
2 transmission header having a virtual path identifier (VPI).

1 18. The system according to claim 1, wherein each link of said
2 plurality of links includes a total bandwidth and provides a guaranteed
3 bandwidth to a user.

1 19. The system according to claim 18, wherein said total bandwidth of
2 each link of said plurality of links is greater than a sum of said guaranteed
3 bandwidth provided by any two links of said plurality of links.

1 20. The system according to claim 1, wherein said transmitter switch
2 further comprises a plurality of transmitter line cards, each transmitter line card
3 being coupled to said first end of a corresponding link of said plurality of links.

1 21. The system according to claim 20, wherein said distinct data
2 transmitted along each link of said plurality of links comprises cells.

1 22. The system according to claim 21, wherein each transmitter line
2 card of said plurality of transmitter line cards further comprises a transmitter
3 classifier module for classifying said cells transmitted along each corresponding
4 link, a plurality of transmitter queuing buffers coupled to said classifier module
5 for receiving and storing said cells, and a transmitter multiplexing module
6 coupled to each buffer of said plurality of queuing buffers and to said
7 corresponding link of said plurality of links for directing said cells stored in one
8 buffer of said plurality of queuing buffers to said corresponding link and said
9 cells stored in all remaining buffers of said plurality of queuing buffers to a
10 disposal bin.

1 23. The system according to claim 22, wherein said transmitter switch
2 receives a virtual connection setup request and assigns at least one virtual
3 connection corresponding to said virtual connection setup request alternatively
4 to each buffer of said plurality of transmitter queuing buffers.

1 24. The system according to claim 23, wherein said at least one virtual
2 connection is associated with said cells transmitted along each link of said
3 plurality of links.

1 25. The system according to claim 23, wherein said transmitter switch
2 assigns said at least one virtual connection to each buffer of said plurality of
3 transmitter queuing buffers in such a way so as ensure that each link has a
4 balanced load.

1 26. The system according to claim 24, wherein said transmitter
2 classifier module allocates said cells to each buffer of said plurality of
3 transmitter queuing buffers based on association with said at least one virtual
4 connection, in such a way so as to ensure that each link has a balanced load.

1 27. The system according to claim 22, wherein each buffer of said
2 plurality of transmitter queuing buffers includes a plurality of Quality of
3 Service (QoS) category queues.

1 28. The system according to claim 22, wherein each of said
2 transmitter line cards further comprises a transmitter processor for monitoring
3 each link of said plurality of links and for programming said transmitter
4 multiplexing module to switch said cells directed to said disposal bin to said
5 corresponding link when said failure is detected.

1 29. The system according to claim 22, wherein said receiver switch
2 further comprises a plurality of receiver line cards, each receiver line card being
3 coupled to said second end of a corresponding link of said plurality of links.

1 30. The system according to claim 29, wherein each receiver line card
2 of said plurality of receiver line cards further comprises a receiver multiplexing
3 module coupled to said second end of said corresponding link of said plurality
4 of links for receiving said cells, and a receiver classifier module coupled to said
5 receiver multiplexing module for classifying and outputting said cells to a
6 plurality of receiver queuing buffers.

1 31. The system according to claim 30, wherein each receiver line card
2 of said plurality of receiver cards further comprises a receiver processor for
3 monitoring said corresponding link, for detecting a failure of said
4 corresponding link, and for instructing said transmitter processor
5 corresponding to said link of said failure.

1 32. A method for protecting a network comprising:
2 providing a plurality of links between a transmitter switch and a receiver
3 switch located within said network;
4 transmitting distinct data from said transmitter switch on each link of
5 said plurality of links;
6 switching said distinct data transmitted along one link said plurality of
7 links to another link of said plurality of links when a failure is detected on said
8 one link; and
9 receiving said distinct data to said receiver switch within said network.

1 33. The method according to claim 32, wherein said network is an
2 Asynchronous Transfer Mode (ATM) network.

1 34. The method according to claim 32, wherein said network is a
2 Frame Relay network.

1 35. The method according to claim 32, wherein said distinct data
2 transmitted along each link of said plurality of links comprises cells.

1 36. The method according to claim 35, further comprising:
2 receiving a virtual connection setup request; and
3 assigning at least one virtual connection corresponding to said virtual
4 connection setup request alternatively to each buffer of a plurality of
5 transmitter queuing buffers in said transmitter switch.

1 37. The method according to claim 36, wherein said at least one
2 virtual connection is associated with said cells transmitted along each link of
3 said plurality of links.

1 38. The method according to claim 36, further comprising assigning
2 said at least one virtual connection to each buffer of said plurality of transmitter
3 queuing buffers in such a way so as to ensure that each link has a balanced load.

1 39. The method according to claim 37, further comprising:
2 classifying said cells within said transmitter switch;
3 storing said cells within said plurality of transmitter queuing buffers;
4 and
5 directing said cells stored in each buffer of said plurality of transmitter
6 queuing buffers in a predetermined order to a corresponding link of said
7 plurality of links.

1 40. The method according to claim 39, wherein, in said storing, said
2 cells are alternatively stored in each buffer of said plurality of transmitter
3 queuing buffers.

1 41. The method according to claim 39 further comprising, in said
2 storing, allocating said cells to each buffer of said plurality of transmitter
3 queuing buffers based on association with said at least one virtual connection,
4 in such a way so as to ensure that each link has a balanced load.

1 42. The method according to claim 35, further comprising monitoring
2 each link of said plurality of links for failure and programming a multiplexing
3 module to switch said plurality of cells directed to said one link of said plurality
4 of links to said another link when said failure is detected on said one link.

1 43. The method according to claim 35, further comprising:
2 merging said cells received on each link of said plurality of links;
3 classifying said cells; and
4 outputting said cells to a plurality of receiver queuing buffers.

1 44. The method according to claim 32, wherein each link of said
2 plurality of links includes a total bandwidth and provides a guaranteed
3 bandwidth to a user.

1 45. The method according to claim 44, wherein said total bandwidth
2 of each link of said plurality of links is greater than a sum of said guaranteed
3 bandwidth provided by any two links of said plurality of links.

1 46. A system for protecting a network, comprising:
2 a first link and a second link located in said network;
3 a transmitter switch, coupled to one end of said first link and said second
4 link, for transmitting distinct data along said first link and said second link;
5 a receiver switch coupled to another end of said first link and said
6 second link, for receiving said distinct data;

7 wherein said distinct data transmitted along said first link is switched to
8 said second link when a failure is detected on said first link.

1 ~~47.~~ A method for protecting a network, comprising:
2 providing a first link and a second link between a transmitter switch and
3 a receiver switch located in said network;
4 transmitting distinct data from said transmitter switch on said first link
5 and said second link;
6 switching said distinct data transmitted along said first link to said
7 second link when a failure is detected on said first link; and
8 receiving said distinct data to said receiver switch within said network.

1 ~~48.~~ A transmitter switch for protecting a network comprising:
2 at least one input line card for receiving data in said network; and
3 a transmitter line card coupled to said at least one input line card;
4 said transmitter line card coupled to each link of a plurality of links in
5 said network;
6 said transmitter line card transmitting distinct cells of said data along
7 each link of said plurality of links and switching said distinct cells transmitted
8 along one link to another link when a failure is detected on said one link.

1 49. The transmitter switch according to claim 48, wherein said
2 network is an Asynchronous Transfer Mode (ATM) network.

1 50. The transmitter switch according to claim 48, wherein said
2 network is a Frame Relay network.

1 51. The transmitter switch according to claim 48, wherein said
2 transmitter line card further comprises a transmitter classifier module for
3 classifying said cells transmitted along said each link of said plurality of links, a

4 plurality of transmitter queuing buffers coupled to said classifier module, for
5 receiving and storing said cells, and a transmitter multiplexing module coupled
6 to each buffer of said plurality of transmitter queuing buffers and to each link of
7 said plurality of links for directing said cells stored in each buffer in a
8 predetermined order to a corresponding link of said plurality of links.

1 52. The transmitter switch according to claim 51, wherein at least one
2 virtual connection corresponding to a received virtual connection setup request
3 is assigned alternatively to each buffer of said plurality of transmitter queuing
4 buffers.

1 53. The transmitter switch according to claim 52, wherein said at least
2 one virtual connection is associated with said cells transmitted along each link
3 of said plurality of links.

1 54. The transmitter switch according to claim 52, wherein said at least
2 one virtual connection is assigned to each buffer of said plurality of transmitter
3 queuing buffers in such a way so as to ensure that each link has a balanced load.

1 55. The transmitter switch according to claim 53, wherein said
2 transmitter classifier module allocates said cells to each buffer of said plurality
3 of transmitter queuing buffers based on association with said at least one
4 virtual connection, in such a way so as to ensure that each link has a balanced
5 load.

1 56. The transmitter switch according to claim 51, wherein each buffer
2 of said plurality of transmitter queuing buffers further includes a plurality of
3 Quality of Service (QoS) category queues.

1 57. The transmitter switch according to claim 51, wherein said at least
2 one transmitter line card further comprises a transmitter processor for
3 monitoring each link of said plurality of links and for programming said
4 transmitter multiplexing module to switch said distinct cells transmitted along
5 said one link of said plurality of links to said another link when said failure is
6 detected on said one link.

1 58. A transmitter switch for protecting a network comprising:
2 at least one input line card for receiving data in said network; and
3 a plurality of transmitter line cards coupled to said at least one input line
4 card;
5 each transmitter line card being coupled to a corresponding link of a
6 plurality of links in said network;
7 each transmitter line card transmitting distinct cells of said data along
8 each link of said plurality of links and switching said distinct cells transmitted
9 along one link to another link when a failure is detected on said one link.

1 59. The transmitter switch according to claim 58, wherein said
2 network is an Asynchronous Transfer Mode (ATM) network.

1 60. The transmitter switch according to claim 58, wherein said
2 network is a Frame Relay network.

1 61. The transmitter switch according to claim 58, wherein each
2 transmitter line card of said plurality of transmitter line cards further comprises
3 a transmitter classifier module for classifying said cells transmitted along said
4 corresponding link of said plurality of links, a plurality of transmitter queuing
5 buffers coupled to said classifier module, for receiving and storing said cells,
6 and a transmitter multiplexing module coupled to each buffer of said plurality
7 of transmitter queuing buffers and to said corresponding link of said plurality

8 of links for directing said cells stored in one buffer of said plurality of queuing
9 buffers to said corresponding link and said cells stored in all remaining buffers
10 to a disposal bin.

1 62. The transmitter switch according to claim 61, wherein at least one
2 virtual connection corresponding to a received virtual connection setup request
3 is assigned alternatively to each buffer of said plurality of transmitter queuing
4 buffers.

1 63. The transmitter switch according to claim 62, wherein said at least
2 one virtual connection is associated with said cells transmitted along each link
3 of said plurality of links.

1 64. The transmitter switch according to claim 62, wherein said at least
2 one virtual connection is assigned to each buffer of said plurality of transmitter
3 queuing buffers in such a way so as to ensure that each link has a balanced load.

1 65. The transmitter switch according to claim 63, wherein said
2 transmitter classifier module allocates said cells to each buffer of said plurality
3 of transmitter queuing buffers based on association with said at least one
4 virtual connection, in such a way so as to ensure that each link has a balanced
5 load.

1 66. The transmitter switch according to claim 61, wherein each buffer
2 of said plurality of transmitter queuing buffers further includes a plurality of
3 Quality of Service (QoS) category queues.

1 67. The transmitter switch according to claim 61, wherein each
2 transmitter line card further comprises a transmitter processor for monitoring
3 each link of said plurality of links and for programming said transmitter

4 multiplexing module to switch said cells directed to said disposal bin to said
5 corresponding link when said failure is detected.

1 68. A method for protecting a network comprising:
2 receiving data in said network;
3 transmitting distinct cells of said data along each link of a plurality of
4 links in said network; and
5 switching said distinct cells transmitted along one link to another link
6 when a failure is detected on said one link.

1 69. The method according to claim 68, wherein said network is an
2 Asynchronous Transfer Mode (ATM) network.

1 70. The method according to claim 68, wherein said network is a
2 Frame Relay network.

1 71. The method according to claim 68, further comprising:
2 receiving a virtual connection setup request; and
3 assigning at least one virtual connection corresponding to said virtual
4 connection setup request alternatively to each buffer of a plurality of
5 transmitter queuing buffers.

1 72. The method according to claim 71, wherein said at least one
2 virtual connection is associated to said cells transmitted along each link of said
3 plurality of links.

1 73. The method according to claim 71, further comprising assigning
2 said at least one virtual connection to each buffer of said plurality of transmitter
3 queuing buffers in such a way so as to ensure that each link has a balanced load.

1 74. The method according to claim 72, further comprising:
2 classifying said cells;
3 storing said cells within each buffer of said plurality of transmitter
4 queuing buffers; and
5 directing said cells stored in said each buffer in a predetermined order to
6 a corresponding link of said plurality of links.

1 75. The method according to claim 74, wherein, in said storing, said
2 cells are alternatively stored within said each buffer.

1 76. The method according to claim 74, further comprising, in said
2 storing, allocating said cells to said each buffer based on association with said at
3 least one virtual connection, in such a way so as to ensure that said link has a
4 balanced load.

1 77. The method according to claim 68, further comprising monitoring
2 each link for failure and programming a multiplexing module to switch said
3 cells directed to said one link to said another link when said failure is detected
4 on said one link.

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